Charging stations for electric and hybrid vehicles

More and more cities, communities and countries in the EU decide in cooperation with power supply companies and car manufacturers to install electro charging stations for building a certain electro mobility in the medium term.

Silence in the car, no engine noise! With the activation of the energy systems a great color coordinated futuristic display shines towards the driver. The green bars of the loading control show almost 100% of loading capacity…
The world belongs to the driver and then the moment comes that makes you forget everything…This distraction reminds of the under turning moment of a diesel vehicle and pushes the passengers with an ahhhh-effect into the seats. The vehicle slides soundless through the streets and the environmentally friendly road user's good conscience goes with. We could drive relaxed this way for hours and days, if the red sector under the green bars didn't continue to appear clearly and the green bars decreased constantly. This development initiates a little adrenalin rush and lives a little on the relaxed situation of the driving experience.

Where can I refuel and how long does it take? These questions now replace all previous and favorable impressions and the driver is hit back into the real world.

Quick loading time 30 minutes with 22kW….OK that can barely be accepted and can be combined with lunch or shopping. The loading capacity shows the last red bar und reveals the driver that the chosen charging station was his last chance. A free charging column sparkles now towards the driver. The relaxation returns. Now just connecting the charging cable of the front area with the column – operating the release and the world moves on.

The display of the charging column shows:

Error "12" no charging possible, please contact the operator…

….now the recovered relaxation gives way for a stress feeling for many hours.

What should happen now? How can I escape from here? Who can help me? Who is well versed?

When this happens more often and becomes known, who will buy an e-car and trust the offered infrastructure? These messages spread more than all the favorable reports of that technology.

What happened?

The charging process takes place on a frequency converter in the charging column. The e-vehicle applies the loading control while connected additionally to the charging column with a data line.

The frequency converter creates with its IGBT switching operation harmonic waves and high frequency interference voltage. These can spread over the electricity supply and over the control line to the vehicle, too. Furthermore the frequency converter is substantially influenced by network effects and the network impedance on the supply side.

http://www.bajog.de/en/technical-report/frequency-converter.html

That leads to fault and shutdown of the charging column.

Which solution does lend itself?

Protections, switches and any kind of switching operation in ms or µs-sector cause symmetric and asymmetric interference voltage and dU/dt - problems up to **10.000V/µs.** Often grounding problems (PE) come along in addition. Even basic faults in the supply network often top the 160dBµV – limit because of the connected customers so voltage peak value results in >140V in the frequency range.

Together with the network supply voltage all in the network located machines and installations are burdened with a peak value of voltage of >370V. The electrical structural elements in the charging column are designed for 230/250VAC and can barely survive a dU/dt – pulse of **200-300Vµs** (depending on capacitance value).

To guarantee a safe function of the charging station the voltage supply to the charging column and the load side to the vehicle must be equipped with an adapted EMC-filter. Oftentimes this is avoided because of financial reasons until problems with the customers arise on the spot.

This is also recommended among experts, for example by the Fraunhofer institute in Kassel.

Quotation:

Dr. Stephan Kloska (VDE Prüf- und Zertifizierungsinstitut GmbH) talked about the new EMC-demands for electric vehicles. As because of the high voltage on-board electric system there are very new disturbance sources and interference sinks in the vehicles. To the disturbance sources belong for example: frequency converter with very high performance, switching with fast transistors or the behavior of the chargers.

http://www.vde.com/de/E-Mobility/Innovationsunterstützung/PruefungundZertifizierung/Documents/VDE_Kompendium_Elektromobilitat.pdf

What has to be noted for EMC – solutions?

1. **Safety**: The current network load (interference voltage >160dBµV, dU/dt> 5KV/µs) often limit of performance of standard structural elements which like in this case are running permanently in the network.
   Among experts is already known that standard structural elements like X2-capacitors are not suitable for continuous use under the predominant network conditions and that they can break down untimely.
2. **EMC-Suitability**: Adapted EMC-Filter must be able during low internal losses to reduce clearly the failure causing interference voltage in the sector of 1KHz – 500 KHz without saturation behavior and guarantee a secured EMC-result for the total frequency range.

http://www.bajog.de/en/technical-report/reason-for-x2-and-y2-demolition.html

http://www.bajog.de/en/technical-report/new-test-parameter-necessary.html

3. Unfit and not adapted EMC-filter can influence prospectively the used smart meter (meter for electricity, gas and water) in the data communication and attenuate broadband the PLC-signal with the filter effect.
   An adapted EMC-solution must attenuate the appearing interference voltage and the dU/dt – peaks and support the data communication between smart meter and data concentrator at the same time.

http://www.bajog.de/en/technical-report/smart-meter-influence.html

Reliability of existing and planned e-charging stations specify prior-ranking the success of the e-mobility in the future.